AMENDMENTS TO THE SPECIFICATION

Please replace paragraph [0026] with the following paragraph:

[0026] Some conventional monitoring systems use a laser interferometer positioned below a rotating polishing pad. However, this type of monitoring system can only take measurements while the laser and optical path through the polishing pad are in alignment with the front surface of the wafer. This situation creates a very narrow time-period during each rotation of the polishing pad that measurements can be taken. ~~The narrow time-period during each rotation of the polishing pad that measurements can be taken.~~ The narrow time-period and the delay between time-periods for taking measurements created by the rotating polishing pad greatly diminish the capabilities of the monitoring system.

Please replace paragraph [0028] with the following paragraph:

[0028] An apparatus for practicing the present invention will now be discussed with reference to FIG. 3. During a planarization process, a wafer 100 may be transported by a carrier 301 to a position adjacent and substantially parallel to a working surface or polishing pad 309. The front surface of the wafer 100 is pressed against the polishing pad 309 fixed to a supporting surface 211, preferably in the presence of a slurry (not shown). The front surface of the wafer 100 is planarized [[be]] <u>by</u> generating relative motion between the front surface of the wafer 100 and the polishing pad 309 thereby removing material from the front surface of the wafer 100.

Please replace paragraph [0031] with the following paragraph:

[0031] The carrier 301 may be adapted to permit biasing the pressure exerted on different areas of the back surface of the wafer 100. Areas of the back surface of the wafer 100 receiving a higher (or lower) pressure will typically increase (or decrease) the removal rate of material from corresponding areas on the front surface of the wafer 100. Removal rates of material from planarization processes are typically substantially uniform within concentric annular bands about the center of the wafer, but often differ

greatly from band to band. To correct for this common problem, the carrier 301 is preferably capable of exerting different pressures in a plurality of different areas while maintaining a uniform pressure within each area. Since removal rates for planarization processes tend to be uniform within concentric bands on the front surface of the wafer 100, the carrier 301 is ideally able to apply a uniform pressure over each concentric band [[o]] on the back surface of the wafer 100. In addition, since removal rates tend to differ from band to band on the front surface of the wafer 100, the carrier 301 is also ideally able to apply different pressures over different bands on the back surface of the wafer 100. Examples of such carriers are disclosed in U.S. Patent No. 5,882,243; U.S. Patent No. 5,916,016; U.S. Patent No. 5,941,758; and U.S. Patent No. 5,964,653 and are hereby incorporated by reference. The greater the number of concentric annular bands, the greater the process flexibility in adjusting the carrier 301 to the problems encountered in the planarization process. However, the complexity and cost of the carrier also increases as the number of adjustable bands increases. A carrier with three (3) adjustable concentric pressure bands is expected to give ~~you~~ improved process flexibility while keeping the complexity of the carrier to a manageable level. Since the need for improved process results is almost certainly going to increase in the future, the preferred number of controllable bands within the carrier will also likely increase in the future.

Please replace paragraph [0033] with the following paragraph:

[0033] A supporting surface 211 may be used to support the abrasive surface or polishing pad 309. The supporting surface 211 may be a rigid substantially planar surface comprising aluminum, stainless steal, ceramic, titanium, polymer or other such rigid, non-corrosive material. ~~Alternatively, the supporting surface 211 for a polishing pad 309.~~ A slurry delivery system (not shown) is preferably incorporated into the supporting surface 211 for delivery of slurry onto the polishing pad 309.

Please replace paragraph [0042] with the following paragraph:

[0042] The flash is optimally repeated as quickly as possible in order to gather the greatest amount of sample data. However, two factors limit the usefulness of extremely fast sampling rates. The first is that each flash provides a tremendous amount of data that

must be quickly analyzed. Data that has been gathered, but that cannot be timely analyzed does not benefit the system. The second factor is that some time must be allowed to pass between ~~measurement~~ measurements in order to permit the relative motion between the front surface of the wafer 100 and the probes 306a-c to move the measurement location. The measurements are preferably evenly distributed, and as close as possible, across the front surface of the wafer 100.

Please replace paragraph [0043] with the following paragraph:

[0043] The spot size of light from the flash lamp 317 is preferably slightly larger than the largest feature that is supposed to remain on the surface of the wafer 100. This will prevent a fully planarized area from giving a false reading indicating that residuals remain. This could happen if a measurement were taken over a large feature with a spot size smaller than the large feature. On the other hand, a spot size that is too big may miss residuals that are smaller than the spot size. The optimum spot size is larger than the largest feature while also being smaller than the smallest residual it is required to detect. As feature sizes continue to decrease and the requirements for semiconductor manufacturing continue to become more stringent, the optimum spot size will decrease. A spot size of one to three mm in diameter is acceptable for the most current semiconductor manufacturing requirements with smaller spot sizes likely required in the future.

Please replace paragraph [0047] with the following paragraph:

[0047] The control system 311 may make immediate adjustments to the planarization process based on the analysis of the measurements. For example, increasing or decreasing the pressure on the back surface of the wafer 100 during the planarization process has been found to increase or decrease, respectively, the removal rate at the periphery of the wafer 100 with respect to the center of the wafer 100. As another example, more or less slurry may be distributed near areas that have been found to need increased or decreased, respectively, removal rates. ~~As yet another example, the rotation speed of the carrier 301 may be increased or decreased, respectively, removal rate.~~ As yet another example, the rotation speed of the carrier 301 may be increased or decreased

to increase or decrease, respectively, the removal rate at the periphery of the wafer 100. However, the preferred method is to use a multizone carrier 301 to alter the removal rate at different areas of the front surface of the wafer 100. Specifically, the pressure may be increased or decreased in zones over areas that need an increase or decrease in material removal rate, respectively, on the front surface of the wafer 100. In addition, the results from planarized wafers 100 may be used to change the process parameters for incoming wafers. This allows process drift within the planarization process to be detected and compensated for as it happens.

Please replace paragraph [0048] with the following paragraph:

[0048] To determine the condition of the front surface of the wafer 100, the location for each measurement should be known. One possible method is to track only the radial position for each measurement and take at least one measurement at various radial positions in ~~find~~ fine enough increments to provide a desired sampling resolution. This method assumes that each measurement accurately represents the condition of the wafer 100 at every point having the same radial position. Since wafers 100 generally have bands that planarize at approximately the same rate, this method provides a simple approximation of the condition of the front surface of the wafer 100. In this manner, measurements may be taken across the front surface of the wafer 100 at a desired spatial resolution that prevents a problem area larger than the desired resolution from going unobserved.

Please replace paragraph [0050] with the following paragraph:

[0050] Alternatively, the measurements may be analyzed until the largest possible remaining residual is of a predetermined size. Once all the remaining residuals are of the predetermined size or smaller, the wafer 100 may be ~~planarization~~ planarized for an additional time (over-polish time) to remove the remaining residuals. The additional planarization time may be found by empirically determining the maximum amount of time necessary to planarize away residuals of the predetermined size.

Please replace paragraph [0055] with the following paragraph:

[0055] The theory behind this discovery is that the material as it is thinned enters a transparent phase to the measurement light or light pulse. In other words, the reflected light is modified by both the surface material (barrier material) upon which the light impinges and the underlying layer (dielectric material). A beneficial factor in using intermediate reflectance spectra 600 is that it occurs before all the surface material is removed and that it is substantially different from the preceding and following reflectance spectra measured during the chemical mechanical planarization process. For example, a layer of Ta or TaN deposited to form a barrier layer in a copper interconnect is deposited having a thickness of approximately 500 angstroms. Performing a chemical mechanical planarization process to remove the barrier layer on the surface of the wafer has found intermediate reflectance spectra 600 to occur when the barrier layer has been thinned to approximately 100 angstroms. The average thickness when this transparent phase occurs and the detectable range around the median should be characterized for each process and material. In this example, intermediate reflectance spectra 600 is highly desirable because it occurs immediately before the all the material is removed or cleared. ~~Thus, allowing a~~ A clear signal thus is allowed to be propagated to the CMP system that the clearing phase will be approaching and to begin looking for the characteristic reflectance spectra corresponding to the material being cleared away such that the underlying layer is exposed. This provides increased control in determining the end point of the process thereby preventing under or over polishing and providing a process control that is uniform from wafer to wafer and lot to lot.

Please replace paragraph [0059] with the following paragraph:

[0059] An illustrative method for planarizing a front surface of a wafer 100 will now be described with reference to FIGs. 2, 3, ~~and~~ 6 and 10. The wafer 100 is placed in a carrier 301 (step 600) and transported adjacent a polishing pad 309. The carrier 301 holds the wafer 100 substantially parallel to the polishing pad 309 while the wafer 100 is pressed against the top surface of the polishing pad 309 (step 601). The carrier 301 may be rotated or otherwise moved in relation to the polishing pad 309 to assist in uniformly

removing material from the front surface of the wafer 100. The supporting surface 211 and attached polishing pad 309 may also be moved in relation to the front surface of the wafer 100 and is preferably orbited. (step 602) The relative motion is necessary to remove material from the front surface of the wafer 100.

Please replace paragraph [0063] with the following paragraph:

[0063] The progress of the planarization process is monitored and analyzed (step 604) for the three different characteristic spectra corresponding to the conditions where the light reflected back is predominately from barrier layer copper 200, the light reflected back is modified by the underlying dielectric layer, and the light reflected is predominately from dielectric 201. In particular, the intermediate reflectance spectra (light reflected back is modified by the underlying dielectric layer) are sought ~~after which indicates~~ to assess when the CMP process is nearing a clearing stage. Normalizing the reflectance spectra of the measurements taken during the CMP process would identify the three different characteristic reflectance spectra such as the sinusoidal shape of the normalized intermediate reflectance spectra.